(d:) REMARKS

The present Action is the first in this application. The Summary to the Action indicated that all of claims 1-36 were rejected. The Detailed Action indicates that claim 33 was rejected as anticipated under 35 USC 102(e) as anticipated by Bernazzani, EP-1,077,441. Claims 1-3 were rejected under 35 USC 103(a) as obvious over Bernazzani. Claims 4-6, 8, 11-15, 17, 20-21 and 23-29 were rejected as obvious over Bernazzani in view of Goldberg, US-3,869,641. Claims 7, 9-10, 16, 18-19, 22, 30-31 and 34-36 were rejected as obvious over Bernazzani and Goldberg further in view of von Bauer, US-5,428,388. The Detailed Action did not discuss claim 32.

Claims 1, 4, 6, 7, 8, 13-17, 27, 33 and 35 have been amended to more clearly define the invention. The rejections of the claims is therefore traversed and argument presented as to deficiencies of the art.

Summary of the Invention

The present invention relates to low light intensity level luminaries used as marker lights. The marker lights utilize a minimum battery installation which supports generation of light without replacement of the battery for a year or longer while retaining a compact exterior size for the marker light housing. The luminaries of the present invention rely on a highly efficient light source, preferably a super bright light emitting diode, which exhibits high efficiency across a broad range of operating voltages. The diode is operated at substantially below its rated current. This low current level causes the diode to emit light at a level producing a response in human eyes at scotopic vision levels. Broad spectrum emission is preferred because it produces a human response at the lowest light levels. Various optical paths are disclosed depending upon the

application of the device in which the light source is placed. Typically the light path is directed to diffusing the light to achieve a broad viewing angle.

Analysis of the References and Comparison to the Present Invention

The Bernazzani reference teaches “a signaling device” which is essentially an internally illuminated emergency exit for use in photographic development labs. In such labs normal light levels can fog film being developed. The signaling device provides sufficient illumination through slots shaped as symbols to allow reading of the symbols in a room illuminated at mesopic levels. The device provides an internal light source, typically using four light emitting diodes, which cast light onto a diffusing surface. The diffusing surface is used to illuminate the information panel uniformly. Light escapes the box through slots which have a width of between 0.5 mm and 1.5 mm. A particular luminance level of light escaping by the slots is determined by appropriate matching of the slot width and the center frequency of the emission light frequency (the spectral bandwidth of which is relatively narrow) of the LEDs. See generally col. 3, lines 19-31. The box is light tight, suggesting that the LEDs are energized to emit light at a greater intensity than the mesopic levels tolerable in the environment of use of the device. Minimization of energy use does not seem to have been Bernazzani’s concern in view of the brief discussion of the source of electrical power for the device. In paragraph [0017] the Bernazzani application states:

> In one embodiment, the energy is supplied from an external source using an electrical connector (not shown) . . .

No battery powered embodiment is shown. It follows that the reference does not suggest techniques to maximize battery life.

Goldberg is directed to an LED indicator light energized from an AC source without providing a rectifying DC power supply. Goldberg provides two parallel

connected diodes oriented to conduct in opposite directions, the combination further connected in series with a resistor and an AC power source. Goldberg is explicitly directed for connection to a conventional AC voltage source (see col. 2, lines 47-65). Goldberg teaches as prior art the use of LED's as indicators in electronic instrumentation. These are described as "a single LED connected in a DC circuit with appropriate series resistance, and such circuit may be powered from a *low level DC supply voltage*." See col. 1, lines 32-35, (emphasis supplied). The Examiner placed a great deal of reliance on this language. However, it is clear from further reading that the terminology "low level" occurs in the context of comparison to AC line voltage. See Goldberg, '641 patent generally at col. 1, lines 39-64 and specifically at lines 45-55 where he states:

> . . . [A]ppropriate AC/DC conversion techniques must be employed to convert the AC line voltage to an appropriate low level DC voltage for forward biasing the LED . . . which is typically in the order of 2.0-1.5 volts DC.

Goldberg does not describe operating LED's at a fraction of their rated *current capacity*, as taught by the present invention, to achieve long battery life.

Goldberg speaks of a low level DC circuit in terms of its voltage level compared to AC line current in order to bring the voltage levels of the circuit down to conventional diode operating levels. However, the focus of the invention in providing a "low (current) level energization circuit" is on current flow, not voltage. Light emitting diodes, like any general purpose diode, are non-linear devices. See Horowitz and Hill, *The Art of Electronics*, pages 44-45, (2nd. Edition, Cambridge 1989). When forward biased they conduct electricity and exhibit a substantially constant voltage drop notwithstanding changes in current. It may be acknowledged that the forward bias voltage drop does increase with increasing current, but this increase in voltage drop is both exceedingly slow and increasingly slowly with increasing current. To operate a diode at all though a

minimum forward bias must be met. Essentially all diodes of a given type, when operated in a forward biased fashion, will exhibit substantially the same "low voltage" drop. The present invention teaches that to prolong the life of a limited power source, current must also be limited to a low level. See for example, page 6, lines 12-23 of the application.

One aspect of the invention lies in exploiting diodes' non-linear operating characteristic, which is related to their exhibiting comparable efficiencies over a broad range of emission intensities. None of the art references recognizes this fact much less teaches operating a diode in a fashion to exploit this characteristic.

In view of Goldberg using AC line power to energize diodes (with a series resistor), in view of his determination that the diodes of his circuit are being operated at 70 milliamperes, a level greatly exceeding the 5 or less milliamperes considered desirable in the invention (see Goldberg '641 patent at col. 3, lines 36-40 and the present specification at page 5, lines 21-30), and in view of use of the term "low voltage" by Goldberg being in the context of comparison of the typical forward bias voltage drop of a diode to conventional AC line voltages, the Examiner's conclusion (page 5 of the Action, first full paragraph) that "it would have been obvious to one having ordinary [skill] in the art to employ the teaching of Goldberg in the system of Bernazzani for providing a *minimum current* to the lighting device." (emphasis supplied) is without basis. "Low level voltage" as used by Goldberg does not equate to "low current level" where the devices in question, diodes, are non-linear devices and the current levels described are more than an order magnitude different. Goldberg at no point describes or mentions the desirability of operating a diode at a minimum, i.e. far below rated, current level.

Von Bauer et al., US-5,428,388 was cited as an example of a wireless doorbell,

which it unquestionably teaches.

Argument and Discussion of Amendments

The arguments advanced by the Examiner in the Action are usually dealt with in the order the arguments were first made in the Action. In some cases counter arguments apply to more than one claim and in those cases several claims have been grouped. The claims are not necessarily dealt with sequentially.

Claim 33 has been amended to improve clarity. The claim has three basic elements: a housing, a light scattering illumination source including a light emitting element operated at a threshold current to emit light at below the level of human photopic vision and an energization source for supplying the threshold current to the light emitting element. Bernazzani fails as an anticipating reference. Bernazzani relies on his housing (light tight fixing box 12) and slots 50 through the box's walls to limit emission of light from the box to levels not disturbing the mesopic light levels in a room. Four diodes provide the light source 14. An energization source of unspecified character supplies the diodes. A light diffusing panel 24 lines the side of the box including the slot. Bernazzani does not teach a current supply energization source which supplies current to the light emitting element causing it to emit light at below the threshold of useful photopic vision or at a level visible to a partially darkness adapted eye. Rather Bernazzani limits light emission from the box so as not to disturb the mesopic light level of a room. See paragraph [0005]. The emission intensity level of the diodes is not discussed. However, the use of four LEDs does not suggest operation at low emission intensity levels and its use of four diodes suggests that a reduced emission level from the diodes is not being used.

Claim 1 has been amended as regards the final element to make clear that the term "low level" refers to low current level energization, consistent with how the term "low level" was used in the present specification. The last element of the claim now reads:

> a low current level energization circuit operably connected to the light emitting diode for supplying current to the light emitting diode to cause the light emitting diode to illuminate the visible surface of the light scattering element at a level below a useful threshold of human photopic vision and above a threshold of scotopic vision.

Bernazzani achieves emission of light at a mesopic level by limiting light emission from the box, which in turn is achieved by making the slots narrow, not by controlling the current supplied the diodes. As a result, using Bernazzani's device to emit light a photopic level would be difficult. However, the capacity to emit light at higher intensity levels is a feature of the present invention. Consider claims 6, 12, 15 and 18 where the capacity to emit light at higher levels is added as a limitation. Because the width of the light transmitting apertures are matched to the wavelength of the light emitted by the LEDs, Bernazzani's device would have great difficulty in exploiting a broad spectrum LED to achieve the greatest perceptibility at a given current. Compare this to claims 2, 28 and 36. Goldberg solves none of the problems of Bernazzani as a teaching, providing as he does a circuit dependant on external line power and supplying current to LEDs at much higher levels (70 amps) than tolerable for the purposes of the present invention. Compare this to claims 4, 13 and 27 (all requiring batteries).

Claim 1 has also been amended to replace the term "light scattering element" with "light transmitting element". This amendment is possibly broadening and is made to reflect a possible embodiment of the invention as described in the specification at page 7, lines 17-26. It was noted there that clear elements could be used to complete enclosure the LEDs and provide the optical aperture that allows the door bells to be seen. The art does not discuss this aspect of the invention

Regarding claim 3 of the present application, the Examiner noted that Bernazzani taught use of an LED as a light source as part of the basis for rejection of the claim. The claim element is not an LED, but rather, a class of LEDs termed super bright LEDs, which generate light at "high" efficiency at luminescence levels below the threshold of human photopic vision. The specification limits "high efficiency" by reference to this class of diodes, which emit light across a broad range of intensity levels with little change in efficiency.

Regarding claim 4 the Examiner argues that Bernazzani renders the claim element "battery" obvious because Bernazzani teaches connecting an energy source to an LED. The term "energization circuit" appeared as an element in claim 1 and the term battery was introduced to specifically limit the broader term. Bernazzani does not teach use of a battery. Use of a battery to supply low current levels achieving long battery life while producing useful levels of light is not a hollow contribution to the art and thus the reference fails to render the claim obvious.

Regarding claim 5, the Examiner refers to Goldberg as supplying the missing "low level DC voltage supply" element from Bernazzani. As argued above, a "low level DC voltage supply", as the term is used by Goldberg, is not necessarily a "low current level" supply. Further, the claim is directed to providing an "ambient light sensitive" switch and not for providing a mechanical "low level (on/off) switch".

The patentable distinctiveness of claim 6 has already been argued. The Examiner's recitation that Bernazzani discloses use of a light emitting diode as a light source and provides a "light scattering element for transmitting light" is not seen as in any way relevant to a claim limitation directed to incorporating into the drive circuit for the LED distinct energization paths allowing the LED to be driven to luminesce at either

a scotopic level or a photopic level.

With respect to claim 8 the Examiner identified Bernazzani as teaching:

a housing with an exterior surface . . .
a light emitting diode as a light source;
a light scattering [optical element] . . .
an energization circuit . . .

However, these points simply pass over both of the new, substantive elements of the claim which require a "solid state switch" and a "photosensitive resistor" for controlling the conductive state of the solid state switch. Bernazzani explicitly does not teach how to energize the diodes he uses to illuminate his box, except to say that such a circuit should include a potentiometer. See EPO- '441 application, paragraph [0017].

Claims 11, 20 and 24 provided for application of the invention to a particular type of housing having an "upright translucent tube" and a "stake . . . supporting the . . . tube". The examiner identifies Bernazzani as teaching these elements, identifying a "translucent [element] 24" with the tube element and some 30 lines of col. 2 of the application as teaching the "stake". Reference to the Fig. 1 of the application reveals that translucent element 24 is substantially flat and not a tube. The cited text from the application nowhere discusses use of a stake for insertion into the ground for supporting the transparent element.

Regarding claims 12 and following through 26, the arguments substantially repeat those made for claims 3 through 11. Claims 12 and following are directed to devices which may use monochromatic LEDs as opposed to broad spectrum LEDs, but otherwise repeat the structures claimed with broad spectrum LEDs. However, claims 21 and 25 describe an embodiment of the invention having relatively opaque symbols applied to a light scattering panel. The Examiner again pointed to Bernazzani, referring

to mention (at paragraph [0007]) of an "opaque information panel". However, Bernazzani goes on to say in the same paragraph that the "symbol" on the panel took the form of the "slots whose width . . . allow light to escape". In other words, the symbols in Bernazzani are not opaque, but light transmitting. Hence Bernazzani fails to teach the claims' symbol element.

Claims 27-32 constitute a second sequence of claims. Regarding claims 27-29 the Examiner based his rejection again on the faulty premise that the "low level DC supply voltage" taught by Goldberg supplied the teaching missing from Bernazzani relating to operating an LED at a current level that would result in it emitting light at a level "below a useful threshold of human photopic vision and above a threshold of scotopic vision" as claimed. As already pointed out, Goldberg provides no such teaching.

Regarding the von Bauer '388 reference, and its application to claims 7, 9, 10, 16, 18, 19, 22, 30, 31 and 34-36, it may be said that while von Bauer teaches a wireless transmitter for doorbells, he does not teach a circuit where the radio transmitter draws its power through an LED normally illuminated by an energization circuit at a low intensity light level, thereby causing the LED to luminesce at a "useful photopic" level. See claims 6 and 7 as a pair, 12, 15 and 16 as a pair, 18, 22 and 31. All of these claims recite features to some or all of this distinguishing attribute. The term "useful" may be considered to be a level at which a person in the presence of the light source could use the light to identify change or find a key.

As noted above, claim 32 was indicated as rejected in the summary of the Action, but was not mentioned in the Detailed Action.

Claims 33-36 constitute a third set of claims. The rejection of claim 33 was rebutted above. Claim 36 is further distinguishable over the art of record based on recitation of a broad spectrum LED, an element allowing the luminaire of the invention to emit useful light at the lowest current levels.

The invention makes possible providing in a form little larger than a conventional door bell switch housing, an illuminated door bell button, powered by an internal battery, and providing a battery life of 1 to 3 years. The teachings of the present invention appreciate, unlike the prior art, that driving an LED at a current far below its rated level can generate low levels of light but at a high efficiency, allowing the use of a compact battery plant to support operation of a marker light for greatly extended periods of time. The art, particularly Goldberg, relying as it does on AC line power, is pointed in a completely different direction, and provides no teaching suggesting a device relying for long periods on an internal power source.

The remaining dependent claims add still further limitations further distinguishing the present invention over the cited reference. Applicant believes the Claims as resubmitted or amended are in condition for allowance and respectfully requests favorable action by the Examiner.

Respectfully submitted,

Date: 16 July 2004
Fort Wayne, Indiana
Tel. No. 260.407.3907

Paul W. O'Malley
Attorney for Applicant
Reg. No. 31, 048

CERTIFICATE OF MAILING

I hereby certify that I caused this Amendment to be mailed to the Commissioner for Patents on or before 16 July 2004

Date: 16 July 2004

Paul W. O'Malley
Attorney for Applicant

THE ART OF ELECTRONICS

Second Edition

Paul Horowitz HARVARD UNIVERSITY

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1.24 Thévenin's theorem generalized

When capacitors and inductors are included, Thévenin's theorem must be restated: Any two-terminal network of resistors, capacitors, inductors, and signal sources is equivalent to a single complex impedance in series with a single signal source. As before, you find the impedance and the signal source from the open-circuit output voltage and the short-circuit current.

DIODES AND DIODE CIRCUITS

1.25 Diodes

The circuit elements we've discussed so far (resistors, capacitors, and inductors) are all *linear*, meaning that a doubling of the applied signal (a voltage, say) produces a doubling of the response (a current, say). This is true even for the reactive devices (capacitors and inductors). These devices are also *passive*, meaning that they don't have a built-in source of power. And they are all two-terminal devices, which is self-explanatory.

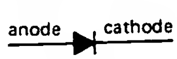

Figure 1.66. Diode.

The diode (Fig. 1.66) is a very important and useful two-terminal passive *nonlinear* device. It has the *V–I* curve shown in Figure 1.67. (In keeping with the general philosophy of this book, we will not attempt to describe the solid-state physics that makes such devices possible.)

The diode's arrow (the anode terminal) points in the direction of forward current flow. For example, if the diode is in a circuit in which a current of 10mA is flowing from anode to cathode, then (from the graph) the anode is approximately 0.5 volt more positive than the cathode; this is called the "forward voltage drop." The reverse current, which is measured in the nanoamp range for a general-purpose diode (note the different scales in the graph for forward and reverse current), is almost never of any consequence until you reach the reverse breakdown voltage (also called the peak inverse voltage, PIV), typically 75 volts for a general-purpose diode like the 1N914. (Normally you never subject a diode to voltages large enough to cause reverse breakdown; the exception is the zener diode we mentioned earlier.) Frequently, also, the forward voltage drop of about 0.5 and 0.8 volt is of little concern, and the diode can be treated as a good approximation to an ideal one-way conductor. There are other important characteristics that distinguish the thousands of diode types available, e.g., maximum forward current, capacitance, leakage current, and reverse recovery time (see Table 1.1 for characteristics of some typical diodes).

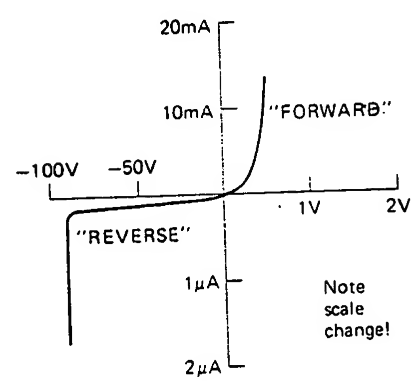

Figure 1.67. Diode *V–I* curve.

Before jumping into some circuits with diodes, we should point out two things: (a) A diode doesn't actually have a resistance (it doesn't obey Ohm's law). (b) If you put some diodes in a circuit, it won't have a Thévenin equivalent.

1.26 Rectification

A rectifier changes ac to dc; this is one of the simplest and most important applications of diodes (diodes are sometimes

called rectifiers). The simplest circuit is shown in Figure 1.68. The "ac" symbol represents a source of ac voltage; in electronic circuits it is usually provided by a transformer, powered from the ac power line. For a sine-wave input that is much larger than the forward drop (about 0.6V for silicon diodes, the usual type), the output will look like that in Figure 1.69. If you think of the diode as a one-way conductor, you won't have any trouble understanding how the circuit works. This circuit is called a *half-wave rectifier*, because only half of the input waveform is used.

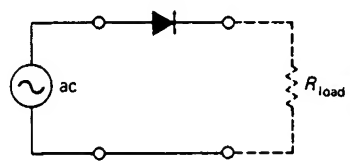

Figure 1.68. Half-wave rectifier.

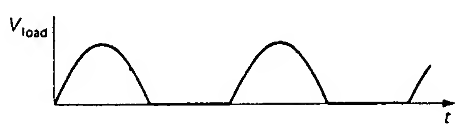

Figure 1.69

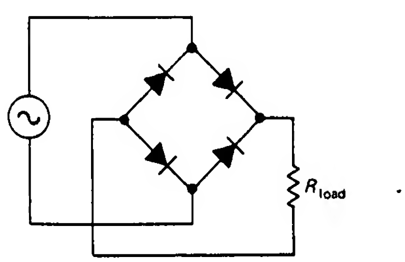

Figure 1.70. Full-wave bridge rectifier.

Figure 1.70 shows another rectifier circuit, a full-wave bridge. Figure 1.71 shows the voltage across the load for which the whole input waveform is used. The gaps at zero voltage occur because of the diodes' forward voltage drop. In this circuit, two diodes are always in series with the input; when you design low-voltage power supplies, you have to remember that.

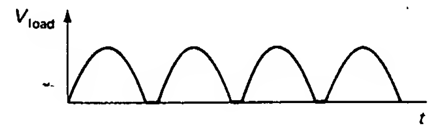

Figure 1.71

1.27 Power-supply filtering

The preceding rectified waveforms aren't good for much as they stand. They're dc only in the sense that they don't change polarity. But they still have a lot of "ripple" (periodic variations in voltage about the steady value) that has to be smoothed out in order to generate genuine dc. This we do by tacking on a low-pass filter (Fig. 1.72). Actually, the series resistor is unnecessary and is always omitted (although you sometimes see a very small resistor used to limit the peak rectifier current). The reason is that the diodes prevent flow of current back out of the capacitors, which are really serving more as energy-storage devices than as part of a classic low-pass filter. The energy stored in a capacitor is $U = \frac{1}{2}CV^2$. For C in farads and V in volts, U comes out in joules (watt-seconds).

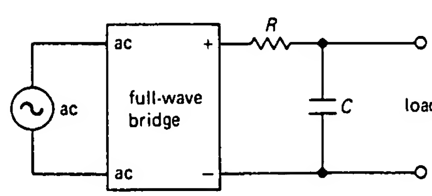

Figure 1.72

The capacitor value is chosen so that

$$R_{load}C \gg 1/f$$

(where f is the ripple frequency, here 120Hz) in order to ensure small ripple, by making the time constant for discharge much longer than the time between recharging. We will make this vague statement clearer in the next section.